USER EXPERIENCE IN MOBILE AUGMENTED REALITY APPLICATIONS – THE DIGITAL NATIVE PERSPECTIVE

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Annie Knape
Johanna Hellsten
Sofi Simberg

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Author/s: Annie Knape, Johanna Hellsten & Sofi Simberg

Supervisor: Patrik Hedberg

Abstract

Characteristic for upcoming technology is that it is growing, constantly developing and fast implemented in people's lives. Augmented reality (AR) is one of these technologies and more companies are implementing AR in their daily operations. AR can be described as a large amount of data, being transformed into images that are attached to the real world. The technique takes digital images and applies it to the reality through a mobiles camera lens. When used for mobile application it is called mobile augmented reality (MAR). MAR applications are expected to be as successful as smartphones was when it was first released. The revenue is set to be over $120 billion dollars by 2020. Even though it sees huge potential, few studies are done on user experience (UX) and satisfaction for the end user. This information could be a crucial asset for AR stakeholders in the prosperous future. A generation of interest for technology stakeholders is the digital natives who are people born between 1980 and 2000. They have been brought up with technology and they are comfortable with adapting to new technologies and they are not late on trying them out. This study combined the three fields of interest, MAR, UX and the digital natives, for the purpose to develop knowledge of what factors within UX that digital natives’ value as most important for a MAR application. A quantitative method with an inductive approach were used to answer the research question. The researchers used a questionnaire to collect the data that was later analyzed with the help of Google Forms, Microsoft Excel and SPSS. Predetermined factors from a theoretical framework was presented to the participants of the study; perspicuity (easy to learn, easy to understand), dependability (predictable, secure), efficiency (fast, organized), novelty (creative, innovative) and stimulation (exiting, interesting). The study concluded that perspicuity, novelty and efficiency were the most important factors of UX in MAR applications according to the digital natives.

Keywords: User Experience (UX), Augmented Reality (AR), Mobile Augmented Reality (MAR), Digital Natives.
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1. Introduction

This chapter describes the background and previous research done in the area concerned. A problem discussion will then emerge that leads to a research question and the purpose of the study.

1.1 Background

Today the technology is constantly growing, further developed and more implemented in people's everyday life. Enterprises have to uphold a continuous development with new technology to maintain a position on the market and being able to grow and expand (Cascio & Montealegre 2013). Augmented reality (AR) is an upcoming technology that more companies are implementing in their daily operations to make them more efficient and to increase their customers experience and satisfaction (Partala & Saari 2015). AR is a technology that combines the real world with virtual products like three dimensional objects, pictures or sounds. This is shown through hardware like a mobile phone’s camera lens (Hongyan, Changbo & Junjuan 2008). This technique is used in e.g. the mobile application called Snapchat when pictures and filters are added into pictures of oneself. Applications like these are called mobile augmented reality (MAR) applications (Craig 2013), which is one of the most increasing areas in AR applications today (Sharma, Mehra, Kaulgud & Podder 2018). The appearance of these virtual settings are of most importance because, if the application using AR functions is lacking in functionality, the consumer will most likely lose the interest of the application and the message that companies want to send will be lost (Yi-Cheon Yim, Shu-Chuan & Sauer 2017).

Recently, many new MAR applications have been released on the market. The Swedish furniture company IKEA launched in the autumn of 2017 an application called IKEA place that allows users to select products from the IKEA catalogue and place true-to-scale 3D furniture in their own home using the lens of a phone camera (IKEA 2018). Another one was Nintendos launch of Pokémon Go in 2016 that had over 65 million users at the top of its popularity (Inap 2018). The well-known beauty brand L’Oreal released their MakeUpGenius application that transforms the users mobile camera into a makeup mirror where you can try on all kinds of makeup from their brand (L’Oréal 2018).

With the increasing usage of AR technology (Sharma et al. 2018) the world will also be more influenced by younger generations like the generation called digital natives. This generation have grown up using technology since early childhood and they speak the digital language when communicating with computers, smartphones, video games and the Internet (Kilian, Hennigs & Langner 2012). This is the future user of MAR applications and they expect a lot in quality and usability. Previous research states that digital natives are born between 1980 and 2000 (Kilian, Hennigs & Langner 2012). Digital natives are used to receive information fast and they consider speed to be the most important factor for digital products (Catchoom 2017). Their expectations and experience of functionality are much higher than for technology user before their age, the so-called digital immigrants. An application must have good time-response, work for a long period, be fun and easy to use. Digital natives do not have time to figure out how an application works instead they want to dive right into it and expect it to work exceptionally. If this is not the case, the application will without a doubt be
replaced. The lack of functionality is blamed directly on the product or technology and not on themselves as users (Catchoom 2017; Prensky 2001).

Research shows that MAR applications have the capacity to reach the same level as when the first smartphone was released on the market and the leading information technology (IT) giants of today have invested a lot of money in AR technology (Tabusca 2015). By 2020 AR is expected to generate $120 billion in revenue (Yi-Cheon Yim, Shu-Chuan & Sauer 2017). It is believed that there will be an avalanche of software for MAR applications in the next few years and that electronic commerce and mobile commerce will be replaced by augmented commerce using AR technology (Tabusca 2015). The people who will educate the young generation of today and lead them into the working environment, lack the knowledge on what they need when it comes to technology learning. This is happening because they have grown up in a time where technology looked completely different than it does today. Known today are that there is a gap between people who are skilled in technology and they who are not (Bennet & Marton 2010).

1.2. Previous research

Up until now, two-dimensional (2D) data usage have been used in a three-dimensional (3D) world. With AR, a third dimension have been added on the usage of this data. In comparison to virtual reality when the reality changes into a virtual world, AR puts virtual products onto the real world. It can help to see extended things in products that can not be seen by just looking at it. Also, it can be helpful when in need of instructions seen as holograms that interacts with the user and goes through each step of the manual. AR is provided via cloud solution and the application that is being used knows the environment by using e.g. GPS functions. A person can also access AR experiences via e.g. barcodes on different object (Porter & Heppelmann 2017).

In an article by Partala and Saari (2015), the researchers addressed the importance of adaptation to new technologies and how they, who cannot do that, will be limited in how they can become members of the changing community. By this, it is important to uplift the user experience (UX) in new influential technology so that people can use and understand the technology such as AR. When people can use emotions to successfully adapt to new technology they benefit the most.

In 2008 a study about how to measure attractiveness of applications was made by researchers Laugwitz, Held and Schrepp (2008). Based on the existing theoretical framework on UX of Hassenzahl, Platz, Burmester & Lehner (2000), five areas were collected by a scree test that valuated the areas as to best explain the variance data. These are supposed to be quick to assess and give comprehensive impression of UX (Laugwitz, Held, & Schrepp 2008). Further explanation about the theoretical framework will be found in section 2.2.

Poushneh and Vasquez-Parraga (2016) conducted a study on AR impact on UX and its outcomes. The participants were randomly assigned to three different treatments where the AR was divided into levels of interactivity, namely high, middle and low. The result showed that AR had a clear impact on UX. With AR the user is provided with information about the product online, which before only was reachable in a physical store. The users appreciated the functionality of the product more and the endless interaction with the virtual information showed an increased user satisfaction and willingness to buy.
According to Irshad and Rambli (2015), there are few studies in society based on the user satisfaction of MAR. Creating a valuable MAR experience have recently become a crucial asset for different industries that use this innovative technology for products and services. Investigations about end-users satisfaction are lacking in scientific research on mobile augmented reality, which is a rapidly growing technology (Irshad & Rambli 2015). When developing applications, UX satisfaction is important to understand in order to link this gap of knowledge between AR and UX (Irshad & Rambli 2015).

When combining the real world with virtual products, Yi-Cheon Yim, Shu-Chuan and Sauer (2017) describes why it is important to make it as trustworthy as possible to the consumer. Trustworthy as in how well a product look in the environment and if the application reflects the reality in a realistic way. If trustworthiness is not fulfilled, the customer will not see the new technology as something that will be eminent and useful as a modern living tool. Vividness is what is first addressed as a problem for AR. It appears when technology is seen in a high-mediated environment. By this, the service needs to be realistic and stimulate the user’s cognitive elaboration process. A good quality of the images will activate a high level of vividness. High level is reached when having a rich media content. AR technology is highly dependent on the consumer and user of technology driven products. If the user senses any hesitation, the interest will fade out. Reasons for this to happen could be, as mentioned in previous paragraph, because the response time is to slow or if the products is not presenting in the desired way. Another major piece of the immersion for AR consumers is the ability to interact with the virtual product. A positive consumer will have a higher satisfaction for the product and this could only be if the technology and the products have a high level of vividness (Yi-Cheon Yim, Shu-Chuan & Sauer 2017).

The opposite of the digital natives are the digital immigrants, people born before 1980. They have had to learn how to use the new technology and adapt to the digital changes in society, at an older age. Between these two generations there are differences in their perceptions about UX of interactive products and the way they behave when using them (Catchoom 2017; Schippers & Mak 2014). A difference between the generations today is that digital immigrants speak a language within the digital age that digital natives can perceive as obsolete, as the younger generation live their lives online and has a natural understanding of tech language. Digital natives are used to receive information really fast. They like to parallel process and multi-task (Prensky 2001). According to Prensky (2001) digital natives contributes to digital growth so strongly that there will be no going back in the future.

Research shows that all people born 1980-2000 who own a mobile, tablet or computer and have access to the internet, do not necessarily need to be interested in all new innovative technologies like AR, just because they are born into a digital world and belong to one digital generation. But they all have a deeper understanding of technology than previous generations ever had (Wang, Myers & Sundarm 2013).

Studies have shown that the difference between gender roles associated with being technically motivated and involved in development, is greater among men than women overall, as more women find that they have less self-confidence in new technologies such as AR according to Volman, Eck, Heemskerk & Kuiper (2005). However, according to Wang, Myers and Sundarm (2013), this is a topic that has been neutralized since both men and women in the generation of digital natives have proven to be quick to adopt new technology and demand more technology when using mobile applications daily.
An interest in adapting new technology to the digital generation is growing among companies, as lack of prior knowledge in some cases has lead to previous expensive and incorrect investments (Kilian, Hennigs & Langner 2012). This generation have higher demands on technology than previous generations (Kilian, Hennigs & Langner 2012) and companies need to keep up with the development and satisfy their consumers, as companies that adapt right technology to digital natives are safer in competition according to PwC (2011).

1.3 Problem Setting
Little research has been done about what digital natives consider important in relation to UX of new technology such as AR, according to references in section 1.2. What is known is that digital natives are faster than older generations to adopt new technologies because they are more willing to experiment. Kilian, Hennigs and Langner (2012) stressed that there is a gap on empirical research in the subject, which has contributed to many corporate investment mistakes. Many companies invested a lot of money in new innovative technologies, but only a few investments have been successful since they did not accurately study their customers demands on UX. This has in some cases contributed to bankruptcy for some companies, due to the lack of knowledge about what makes their users satisfied. In section 1.2, Irshad and Rambli (2015) explained that AR is a rapidly growing technology. Because of the narrow field of studies in the subject related to UX, companies cannot implement the technology.

The researchers discovered two important factors to take into account in this paper. Firstly the new generation of technology seekers, digital natives. Secondly the importance of UX that needs to be pointed out when working with AR technologies. This is because the users must be able to understand the product or technology in order to use it. Prior research has explained that the digital natives have a higher demand on UX (Schippers & Mak 2014), it has also stressed the importance of vividness for an AR application (Yi-Cheon Yim, Shu-Chuan & Sauer 2017). According to the authors, what remains unclear is the combination of the three research fields. The importance of the combination of a digital native and UX on a MAR application.

Research sources takes up the future aspect of AR and the upcoming advantages of using such technology in different fields (Irshad & Rambli 2015). By the time AR hits the broader market, the generation of digital natives will be one of the big target groups (Prensky 2001).

1.4 Research Question
In section 1.3, the researchers point out the upcoming AR technology and the importance of UX in MAR applications and also the demands in this subject from the generation of digital natives. The weakness of previous research in these three topics combined is what led up to the research question:

- What are the most important factors of user experience in mobile augmented reality applications according to the digital natives?
1.5 Purpose

The goal when creating a new application is to meet the target group demands. For this to happen a developer must know what makes it interesting enough so that it reaches loyal users. When a user is loyal it means that they will stay with the application and also come back to use it. Being able to achieve this, a developer must know what the users demand from the application (Kotler & Armstrong 2010). Previous research continuously takes up the fact that information about AR in relation to UX is lacking. Despite the fact that the technology is still constantly growing (Irshad & Rambli 2015; Kilian, Hennigs & Langner 2012).

The purpose of this paper is therefore to develop knowledge of what factors within the UX theoretical framework developed by Hassenzahl et al. (2000) the digital natives value as most important in MAR applications. By that, also get a better understanding of what lacking factors makes a digital native switch to another application in a blink of an eye and help preventing this in future development. The age range within the generation of digital natives is quite large, this can lead to different perceptions on UX. To get a deeper understanding and an overall picture of the generation, the researchers will also be analyzing divisions in gender and age of the digital natives, for the purpose of facilitating the development of UX in future applications for this target group.

1.6 Potential Stakeholders

According to Kilian, Henning and Langer (2012), there is a void of empirical investigations missing within the field today. Therefore, also described in 1.5, the researchers found the purpose of this research to develop more knowledge about UX in MAR applications. The results from this research could be useful for developers and companies currently working with UX in relation to MAR applications and want to target the digital native generation. The result could also be of interest for researchers who wants to deepen their understanding within this area, which in turn can provide valuable information to future potential stakeholders. Also the education sector could benefit from using AR technology. Instructions could be given via AR technology e.g. holograms that overlap the reality and interacts with the user (Porter & Heppelmann 2017).

1.7 Delimitations

For this research, focus was chosen to be towards UX, based on a predetermined theoretical framework. The research focused on the perspectives of the digital native generation. The researchers also limited their research to MAR application. Finally, the geographical area of research was set to Sweden since this is the researchers country of accommodation.
2. Theoretical References

The second chapter introduces the theoretical framework for the subject concerned and is used to support the analysis. This chapter describes the selected topics augmented reality, user experience and digital natives at a deeper level and facilitates understanding of the researchers' chosen area.

2.1 Augmented Reality Technology

AR can be described as a large amount of data, being transformed into images that are attached to the real world. The technique will help people to translate 2D information into usable 3D information, which enables them to process physical and digital inputs at the same time (Porter & Heppelmann 2017). AR uses virtual objects and applies it to the real world. 3D objects, tracking and positioning are tools used when creating AR (Hongyan, Changbo & Junjuan 2008). AR is influencing the new way of marketing products online and it can improve the buying experience for the consumer. The technique has been successfully used in many industries like the tourism, beauty and interior industry (Pantano, Rese & Baier 2017). Many people do not know they use AR every day, take the example of Snapchat. The picture filters are one way of explaining AR, or if someone have a collision warning system in their car, then that person is also already a user of AR. What AR really does is to combine physical moves with digitized products. In an easy and quick way, the user get access to information she or he does not want to be without. AR is predicted to be imposed in every industry and educational system in just a few years (Porter & Heppelmann 2017).

There are two primary factors that need to be processed for an AR application to work and it is called the two-step process of AR. The first one is the fact that the applications need to have whereabouts information of the currents states of the physical and virtual world. For the second one, the user of the application need to feel the virtual objects as integrated in that person's real life. For this to happen the application will have to display those virtual objects as a part of the real world (Craig 2013).

The hardware structure of an AR application is combined out of three major components. Sensors, a processor and a display are required in order for the fundamental factors, previously mentioned, to work (Craig 2013).

A sensor is something that provides the AR application with real time information about the physical world. This can include tracking sensors, environment information sensors and user input sensors (Pagani, Henriques & Stricker 2016). For tracking sensors, a term called the six degree of freedom is required. It localizes X-, Y- and Z directions, plus yaw-, pitch- and roll axes to set the right position. Since the application wants to determine the exact position and surrounding whereabouts, all these measurements are important. The purpose of using tracking sensors is to get as much information about the world around as possible (Schall 2012). One way of finding out a location is to use a camera because it can see where surrounding things are. To navigate locations the AR application can use a global positioning system (GPS). A GPS utilizes satellites to determine location X, Y and Z but cannot receive information about yaw, pitch and roll. Other ways to find out a location is to use accelerometers, compasses and gyroscopes (Craig 2013). The environmental information sensors give real time information about the surrounding e.g. temperature and humidity. User input sensors investigate the human moves and could be things like buttons or a touchscreen.
A processor is the core center of the AR system. It organizes and analyzes the previous mentioned sensors inputs. It can consist of more than one processor system. After this, the signals are sent to the displays. The processor are required to have enough power to be able to execute the tasks e.g. when a button is being pressed. The microprocessor graphical processing unit (GPU) is a main part of the processor and is used when 3D objects are to be presented. A display is a device that provides stimuli to the user. The display will alert the users senses and how the person should act upon it. This could take place on a screen e.g. tablet screen or as hearable sound from a speaker. In summary, a display is something that presents something to the user, with a high detailed level (Craig 2013).

In order to have a working AR application the system also need software. AR applications need to have following four categories; directly involved software, software to create the AR application, software to create content but also other software that could be beneficial in an AR application (Craig 2013).

The first category involves environmental sensors that connects the AR application with the sensors e.g. camera or audio input and makes the information viable. Application engines processes the information and passes the information forward to the rendering software. The rendering software sends output to displays, like visual output. The second category contains of software that are alike other media producing applications like development software. Next category creates the 2D and 3D content for the application but also sound to extend the UX. The last category puts it all together with the help of e.g. debugger and compilers (Craig 2013).

### 2.1.1 Mobile Augmented Reality (MAR) Applications

MAR is currently one of the most increasing areas in AR applications today (Sharma et al. 2018). For an AR application to be considering as mobile, it should be usable at anytime and anywhere. The hardware required for a MAR application needs to be something that you can carry with you everywhere. That is why smartphones and tablets are the most used hardware tools for these kinds of applications. Smartphones are easy to operate wherever you are and they fit inside your pocket. Likewise are tablets mobile devices that you can carry around without any struggle. Laptops and handheld gaming consoles can also be considered to belong to the group of mobile devices (Craig 2013). It was forecasted that the smartphone penetration rate in Sweden would reach 81.18 % in the end of 2018. Another survey showed that in 2017, 85 % of the people in Sweden had access to a smartphone (Statista 2018). This explains why MAR applications have had such an explosive growth - the users already own the hardware needed. Which in turn leads to a low development cost, compared to more permanent or special-purpose technologies where the user has to buy new hardware. Smartphones and tablets take market shares on a daily basis and at the same time their cost are dropping (Craig 2013). As mentioned in section 1.1 several new MAR applications have been released to the market just in the recent years.
2.2 User experience (UX)

UX describes the users interaction and experience when using applications, websites, systems, services, products etc. The definition of a good UX is when the user gets all of his or hers needs covered (Norman & Nielsen n.d.). When a person experiences something, he or she is at the center of that experience and therefore the experience is very individual (Jinwoo 2015). Despite this, common requirements for the used platform is that it has to be fast, functional, easy to use and entertaining while also being elegant. There should be no disturbance or hassle. The importance of these needs vary among users of different ages who have different opinions. It is therefore important that the developer and other stakeholders can meet the client’s expectations and needs for the platform (Norman & Nielsen n.d.).

Hassenzahl et al. (2000) presents a research framework about UX and how to evaluate it. These researchers describe a number of different quality dimensions and divide them into two different aspects: ergonomic quality (EQ) and hedonic quality (HQ). EQ refers to the usability of the product. This aspect describes the underlying human need for security and control. According to the researchers the more EQ a product has, the easier it is to reach task-related goals with effectiveness and efficiency. EQ focuses on goal-related functions and design issues. HQ addresses the quality dimensions, not task-related goals such as originality and innovativeness among others. What the aspect refers to is the human need for novelty or change and social power. That could be met by visual design, sound design, novel interaction techniques or novel functionality. In 2008 a study was conducted on how to measure UX with the help of a questionnaire. The study had a satisfactory level of reliability and constructive validity. The questionnaire was created by Laugwitz, Held and Schrepp (2008) but based on the theoretical framework of Hassenzahl et al. (2000). With the help of usability experts, terms and statements on UX was collected and formed into a first questionnaire. This was later used in several empirical studies and the data was subjected in a factor analysis. From this analysis five factors were found to show the level of UX attractiveness. The researchers of the analysis could later distinguish the main factors needed when measuring UX which were Perspicuity (easy to learn, easy to understand), Dependability (predictable, secure), Efficiency (fast, organized), Novelty (creative, innovative) and Stimulation (exitng, interesting) (Laugwitz, Held & Schrepp 2008).

2.2.1 Perspicuity

When looking at a screen, a user is confronted with visual stimuli. Then a visual search process begins, often a search for objects, icons or text information. First gathered by looking at the whole screen as a map. In the second stage the user starts reading the objects and small parts of the screen is being processed in detail (Mátrai & Kosztyán 2012). This is when the factor perspicuity comes in. The meaning of the term is that the interface of, for instance an application, is easy to understand and easy to learn (Laugwitz, Held & Schrepp 2008). If an applications interface is perspicuous the user will be able to follow the shortest route to click on the perceived target. The user strategy and navigation inside will thereby be global. If the interface has a more crowded and disordered interface the strategy becomes local. The user then needs more time to find his or hers ways to the target. Local interfaces make the user concentrate on a smaller part of the screen and then he or she have to go through several smaller part to cover the whole screen in order to find the target. If the application is perspicuous the user include the whole screen while searching for its target. Analyzing reaction times can therefore show whether the interface is so or not. When the user discovers
targets easily, it takes approximately the same time to find each target; this means that the trend is linear. When the interface is crowded or disordered the trend is exponential, which shows that users need more and more time to discover the next target (Mátrai & Kosztyán 2012).

2.2.2 Dependability

Dependability in this study means if a MAR application feels trustworthy and secure to use but also if it matters who have developed the applications (Laugwitz, Held & Schrepp 2008). A dependable application or other complex system can be relayed on in today’s modern society. People have integrated themselves with the systems and usually take them for granted (Brombacher 2007). Technology can fail and be faulted and if it does it emits security breaches and by that vulnerability. That is why security is of great importance when it comes to connecting things to the Internet (Kopetz 2011). Security is also a perspective to address in this study since MAR applications are working via cloud solutions. The Internet of things (IoT) is the name of computerized products and products connected to a network, like MAR applications and all these products are expected to link all connected devices that people use and have access to, in the future (Lindqvist & Neumann 2017). IoT is making security more important since it connects systems. Information security also deals with questions concerning authenticity, integrity, confidentiality, privacy and availability. These topics have been heard more because of several reasons. One of them is the fact that computers are controlled by other computers. This makes the system vulnerable to outsiders with intrusion intentions. Also the fact that applications and other systems are always online makes them more of a target for hackers (Kopetz 2011). Roesner, Kohno and Molnar (2014) argues that an AR application is set of three security challenges where the first one is input, by means a mobile camera, a GPS or for instance a microphone is always turned on and becomes vulnerable to malicious applications. Output is what the user gets back and is the second security challenge. Data access is the third and have to do with the constant affiliation to the Internet. Malicious applications can harm us in many ways e.g. by giving false output or by leaking users information to backend servers.

2.2.3 Efficiency

In UX, efficiency defines if an interface is structured and organized in a way that makes it fast to use. The efficiency in an application have a strong connection to the perspicuity of the interface (Albert 2013). As described earlier, if the applications interface is perspicuous, the user will be able to follow the shortest route to click on the perceived target as they see the interface as a whole map (Mátrai & Kosztyán 2012). Perspicuity and efficiency is therefore often measured in the same way, typically by measuring the number of steps it takes for a user to perform a number of tasks. To increase the efficiency the aim is to minimize the amount of effort, each action the user performs, the more effort is involved. In previous research two types of effort is described; cognitive and physical. Cognitive effort includes understanding how to find the right place from the interface where the actions can be performed and how to make decisions about what links or clicks are necessary for the user to perform the action but also how to interpret the result. Physical effort includes the physical action the user does to perform such as moving inside an application or clicking on an item (Albert 2013).
2.2.4 Novelty

Novelty in AR application is presented when new and creative features are displayed (Laugwitz, Held & Schrepp 2008). It is known that enterprises that supply their customers with innovative experiences, dominates the market. If enterprises do not take the opportunity of providing new solutions to the application users, they could be left behind by the ones who do that (Kim 2015). When designing systems the different human situations need to be considered because it involves both intuitive and rational problem solving systems of the human mind (Kopetz 2011). A system-user evaluates the experience after she or he have used the system. Value is what is being evaluated. Novelty will add value in a hedonic way since it refers to emotional satisfaction or pleasure that a person receives from the service. When someone have an unexpected but pleasant surprise within UX it is called serendipity. There are two ways in which this experience can be positive. The first is when someone meets something new in a system. The other way is when the user finds useful information in a new context. Serendipity adds value since it provides unexpected value-added experiences. Hedonic value from serendipity comes in the form of positive unexpected values. A person who finds a system from an unexpected experience tend to use it more in their everyday life (Kim 2015).

2.2.5 Stimulation

By stimulus means that the user experiences something on a deeper level that catches interest and is experienced mainly by variation, different events that arouse curiosity and the desire to continue to e.g. play a MAR game (Raymond 1985). If a MAR application is interesting to use and creates a valuable experience for the user, the higher the mental stimulation the user will feel (Kim 2015). An increased mental stimulation will make the user more excited and motivated to continue using the MAR application. MAR applications are generally more interesting, imaginative and stimulating for the mind to a greater extent than other applications that do not use 3D technology (Kim 2015). With perceived stimulation, the user becomes more attentive and tends to stay more actively engaged. The opposite means that the user is undermined, this leads to less focus on the product and the user becoming bored (Raymond 1985).

2.3 Digital natives

Digital Natives is a term for describing the generation of people who grew up in the digital age (Prensky 2001). They are comfortable with technology and computers at an early age. This is because they have been born into a society where internet, computers and technology have already been so developed that they consider it natural and a necessary part of their everyday life (Prensky 2001). This digital generation is also mentioned in some contexts where they are called differently, e.g. names like millennials and .Net generation. According to Kilian, Hennigs and Langner (2012), it is considered that they are born between 1980 and 2000. What the people of this generation have in common is that they are more used to orienting themselves on the internet and with the help of computers, tablets and smartphones (Prensky 2001). They are faster than other generations to adopt new technologies and media innovations on the market (Kilian, Hennigs & Langner 2012). Previous research has shown that this younger generation has
higher demands on technology than previous generations who have been taught to adopt and accept the technology to keep up with digital development (Kilian, Hennigs & Langner 2012).

Many people in the generation of digital natives believe that mobile applications are addictive, they want to be online via their mobile all the time according to Hahn (2011). This generation is quick to read, filter and share information via applications and they are more involved in technology like AR with different functions. The use of the internet and the expansion of technology have led people to integrate more with each other in the virtual world and with like-minded people on a global level, more than they do offline. They participate in various virtual communities to socialize online through applications, where they can meet other people they feel connected to (Hahn 2011).

The digital natives online lifestyle has led to a lack of commitment to security issues, as sensitive data about themselves is constantly being released via, for example, MAR applications that have access to both the mobile camera and the mobile's GPS (Palfrey & Gasser 2008). Most digital natives are considered to have knowledge of the risks involved in disclosing personal data online such as ID hijackings, fraud, theft and identity violation, but few people in this generation make any concrete actions on security issues to protect their identity and private information. Most people download a new application without checking out the developer, which company is behind it or if there are any other risks (Palfrey & Gasser 2008).

The previous mentioned facts about digital natives are what make this generation the focus group of this study. They are comfortable with technology and they have it as a natural part of their life. What makes this generation interesting is their technological skills, received from an early age compare to previous generation and they have a higher demand on technology, which they more openly try out.
3. Method

The following chapter presents the choice of method, research approach, the process of conducting the study and research design but also survey participants, material used and the pilot survey. The chapter ends with a description of validity and reliability of the survey.

3.1 Research Perspective

The relationship between people and physical environment is changing where technological solutions, like decreasing costs for physical devices are more approachable (Tamayo, Barrio & García 2018). The research methodology is the strategy in how to answer the research question most successful. In line with the question, this study will be made using a quantitative strategy. A quantitative strategy focuses on quantitative data and a positivistic philosophy. The quantitative data usually shows in values that come from numbers and measurements. The measurable data will make the result more trustful. One way of getting quantitative data is from survey research. When conducting a survey study, the examiner gathers information from a group of people, regarding a specific topic. A group of fewer people is to reflect a large group of people. This research design is used for at three purposes, which are exploration (to see what the study group are interested in), description (to get to know more about what the study group thinks of something) and explanation (to see the causal relations between the theoretical constructions of the study group) (Recker 2013).

Since the purpose of the thesis is to develop knowledge on UX in MAR applications, a quantitative approach with a survey study will be used to get a reliable result and which is to reflect a large population.

Tamayo, Barrio and García (2018) describe how AR is a key element in information science today. Since AR uses both the real world and virtual elements the result of the application will depend on both the developer and the physical environment. Surveys done within this field can be used when doing research on e.g. interaction design and how the developer can reach a high satisfaction among the users. The relationship between technology and people are highly influenced by human factors (Tamayo, Barrio & García 2018). Each person has five senses; vision, hearing, taste, smell and touch. People absorb information from all senses but vision is the most used sense. About 80% to 90% of the information that is being provided to us is accessed through vision. How much information a person can process is set by the individual mental capacity, which is also called cognitive load. When someone use one sense to do a mental task, a person derive the capacity to collect information from other senses (Porter & Heppelmann 2017).

3.2 Research approach

This study will be conducted based on a quantitative approach. Previous studies within the field have been based on both quantitative and qualitative approaches. For this study the chosen approach is more suitable since a qualitative study could lead to more subjective answers (Lendahl & Högnäs 2018). A quantitative approach will give a broad perspective of digital natives and by adding open-end questions, the study could be investigated further (Recker 2013).

The researchers of this study want to develop knowledge about AR in relation to UX and digital natives. This will be studied out of five areas from a predetermined theoretical
framework, referred to in section 2.2, concerning the attractiveness of MAR applications. These areas will be used since they can explain UX out of a questionnaire (Laugwitz, Held & Schrepp 2008). The researchers decided to limit the research to these five factors since this has previously proven to be an effective way to measure UX. The five factors were chosen to reflect UX on MAR applications in the best way possible.

3.3 Research design

The research design will reflect the planned outcome of the research. This study will do research on the combination of three known fields and how they correlate with each other. Doing a questionnaire where the participants answer on a scale, what they think of different factors when it comes to UX, will do this. Observation research will bring understanding to common experiences, which will be detected during the survey study. This strategy uses exploratory research and must be independent, reliable and precise in order to find out what was previously unknown and result in a phenomenon within UX. This research will use an inductive approach where facts will be interpret and concluded after being observed since the answers of the participants can’t be predicted in advance (Recker 2013). By doing this research, more generalized conclusions can be made out of the answers from the survey (Edgar & Manz 2017). Inductive research can result in weak or strong inductions. Weak when a very broad generalization is made. The survey that will be made cannot involve all of the digital natives in chosen areas but will be an extract and build a general theory of the generation (Recker 2013).

3.4 Research process

When the study was first initiated it started with the researches interest in AR technologies. When reading the previous literature the researchers found lot of information regarding UX. In relation to AR many researches stresses the importance of vividness in such technologies and applications (Yi-Cheon Yim, Shu-Chuan & Sauer 2017). The researches then found an area where the previous research was weak; no information could be gathered about UX on MAR applications in relation to the generation of digital natives. This led to the research question, “What are the most important factors of user experience in a mobile augmented reality application according to the digital natives?”

This study was decided to have a quantitative approach with an empirical data collection. The collection of data was then decided to be based on the quantitative method of a questionnaire. The researchers started to design their questionnaire with both closed and open-end questions. The closed question was designed to answer the five chosen areas within UX - perspicuity, efficiency, dependability, stimulation and novelty. The open-end question gave the opportunity to catch the participant’s own experience of what they think is important in UX. The survey were handed out physically to digital natives in Borås and Gothenburg and later collected. The survey was also shared on social media platforms to be able to reach a broader audience. Many people use social media on a daily basis (Chordas 2013). Social media platforms are driven by user-generated content and are combined of technology, communications and social interactions. The research aims to reach as many people born between 1980-2000 as possible, and that is why social media became the chosen method for spreading the survey (Hoffman & Novak 2012). Digital natives are surrounded by computers, cellphones, cameras, video games etc. Hence this, social media is a big part of their life. The
digital age will require today companies to adapt internal communications that fits these people’s needs. Studies show that the most popular social media activity is to visit social media platforms (Friedl & Verčič 2011).

AR is a tool for humans when performing tasks and thereby, research has to consider the difference in individuals. Gender is considered something that is psychological constructed (Venkatesh, Morris, Sykes & Ackerman 2004). That is why the research had three options when choosing gender; female, male and other. The option of other was added since people can identify with neither the female or male gender. New technologies are supposed to be used by individuals and that is why it is important to look at each gender variable, to understand different humans perspectives (Venkatesh et al. 2004). The researchers choose to examine the age of the respondents to see any differences in their perceptions. There is a span of 20 years within the generation, because of this the opinions can be unequal. By doing this, the knowledge of the target group was increased.

The findings in the empirical data collection were gathered in Google Forms, which directly summarized the answers into bar charts that gave a clear result on the research question. For further analysis, the collected data in Google Forms were converted into an Excel document. The researchers began to code the data by converting all string values into numeric values for it to be compatible with the statistical software SPSS. This software is commonly used by academics and professionals within different sectors. It eliminates time-consuming data preparations and is easy to read and analyze (The SAGE Encyclopedia of Educational Research, Measurements and Evaluation 2018). A T-test was conducted since it shows how the collected data from a sample group will reflect on the population. The test compares the mean value from two constructed groups. That was why both the gender and age was divided into two separate groups (Burrell & Gross 2018).

3.4.1 Design of questionnaire

The questionnaire (see appendix one) is a mix of closed and open-end question. It contains of seventeen questions in total, one of which are an open-end question. The questionnaire is designed with closed questions to cover some general information about the participant and the areas perspicuity, efficiency, dependability, stimulation and novelty that will measure the attractiveness within UX (Laugwitz, Held & Schrepp 2008). There were two questions under each of these subjects and the participants answered them on a scale from 1-5. Then the researches ended the questionnaire with one open-end question for the possibility of a broader viewpoint of UX in relation to MAR applications. They also got an opportunity to catch the participant’s own experience of important factors within UX. The survey begun with a short text summarizing what AR and MAR applications are in case the participants would not have any previous knowledge about the technology.

Perspicuity - How important is it that the MAR application is easy to use? How important is it that the MAR application is easy to understand? With these questions the purpose is to get an understanding how important the level of complexity is on an MAR application for the users.

Efficiency - How important is fast time response in a MAR application? How important is it that the MAR application is functional to use? The second subject takes up efficiency in an application and aims to find out if the users think time response is important.
Dependability - How important is it that the MAR application is developed by a reliable source? How important is it that the MAR application feels trustworthy and secure? The first question is to find out if it matters to the user if the application is developed by a reliable source, for example a well-known company. The second questions takes up security.

Stimulation - How important is it that the MAR application is interesting to use? How important is it that the MAR application is fun to use? This subject is about how interesting and exciting an application is to use. Is it important that the application awakes an interest when it is used? Does the user change application if they find a likewise application with the same functions that is more interesting to use?

Novelty - How important is it that the MAR application has a creative interface? How important is it that the MAR application has creative features? As a continuation on the questions above, this stresses the subject of creativity and innovation.

After these closed questions the participants were asked to choose what they think are the two factors that they value the most of perspicuity, efficiency, dependability, stimulating and novelty. Since the questions above are answered with a scale from 1-5, the researchers saw an obstacle with possible duplicates. This question will give the researchers a stronger basis on what the participants value as most important. The questionnaire then ends with one open-end question.

Are there any other factors related to user experience (besides from those mentioned above) that you think is important in an MAR application? This open-end question gives the participants an opportunity to write their own experiences of UX.

3.4.2 Participants

The researchers have focused on the generation of digital natives, born from 1980 until 2000 today between 18-38 years old. In the physical execution of the quantitative method, the study was delimited to the Swedish cities Borås and Gothenburg since these are the researchers present cities of accommodation. The hope was to reach out to major parts of the digital natives, operating with the mobile AR technology, and form an idea of what they value as important factors. In order to reach a wider range of users, the researchers decided to share the questionnaire online as well.

3.4.3 Material used

The tools used in this study are the following:

1. Google Forms, to create and send out the online surveys to the participants.
2. Social media platforms were used to share the online survey.
3. The survey was converted into an Excel-file to enhance readability when analyzing the data.
4. Statistical software SPSS, to compare mean values of the collected data.
3.4.4 Pilot study

Before conducting a large-scale survey the researchers wanted to do a pilot test on the questionnaire. By doing such a test the researchers sampled comments from a small group of people who had the same characteristics as the target group. Revisions were made to the survey prior to those comments, in order for the study to be more understandable and to increase the final results (Recker 2013). An internal pilot survey was conducted, where the researchers administered the intended questionnaire to five people from the target generation born 1980-2000. The term “internal pilot survey” consider the respondents in the pilot as the first participants in the main survey (Sincero 2012). As recommended by Converse and Presser (1986) the first method chosen was participatory pilot survey where the participants were in advance informed that they will participate in a pre-test. The researchers asked the respondents to give feedback about the structure of the questionnaire, if the instructions and questions were clear enough. They were also asked to leave their overall reactions, comments and suggestions on how to improve the questionnaire.

Presented below are the results of the feedback that the respondents gave:

- In the top of the questionnaire a text with information about AR and MAR applications is presented. The researchers understood that the participants of the study had trouble understanding the explanation. Evaluation also showed that some did know about the technology but could not reckon the name of it. This text was shortened to make it easier to read and the general information more understandable.

- There were questions that the participants felt were unclear to what information the researchers were looking for. This could cause participants to perceive the question in a different way than it was intended. Changes was made to these questions to prevent difficulties in the analyze and the outcome of the result being invalid due to misunderstandings.

- A general advice was given to the researchers from the respondents regarding the questionnaire. There is a risk that all answers given in the questions with scale 1-5 (question 6-15) will get the answer 5. It is in there beliefs that many people perceive the factors regarding UX, as something users obviously think is important. The researchers had this in mind in advance and therefore had the question where the participants were asked to mark what two factors they found most important out of the five factors.

3.5 Evaluation criterias

Reliability and validity are important to measure because it affects the quality of the quantitative study (Meyer 2012). The researchers used the criteria reliability to find out if the results were reliable and validity to measure the relevance of the study (Meyer 2012). To increase the credibility of the study, the questionnaire was designed in a way that the participants would understand the questions (Recker 2013). To increase reliability the questionnaire is based on a reliable framework for UX that had been proven successful. It is important that quantitative methods are based on a reliable measuring instrument. The data collected from the research questions responds to what the researchers have decided to measure, which makes it valid (Recker 2013).
3.5.1 Validity

The quality of the study can be measured in different ways. One way to measure the quality is to evaluate the validity of a study. When a study is valid it supports the accuracy of the theories about UX that will be build. The study will be validated when the collected data is reviewed and fills a function which in this case is to give an understanding of what factors that digital natives find important in MAR applications (Perron & Gillespie 2015). Previous research shows that vividness is of importance for a good UX, which is if the application has good image quality and is realistic to the user (Yi-Cheon Yim, Shu-Chuan & Sauer 2017). Digital natives speak the digital language. They want to have many information stimuli at the same time and they want it fast (Prensky 2001). The purpose of the study was to examine digital natives perceptions of UX in MAR applications. The findings later validated the study since the result can help multiple stakeholders within the AR area. The researchers found one possible thing that could danger the study. The fact that people who are born before and after the set age limitations could answer since the questionnaire was distributed online. No barrier stopped them from participating since they could answer a different age than they actually are.

3.5.2 Reliability

If variables are measured several times and the values are consistent, the result is reliable. The measurements have to be subjective to the observers since that can lead to bias results. All participants in this UX survey will have different knowledge about the asked technique and will view the questions in accordance. The questionnaire will be objective since it will have to consider all aspects of the participant different backgrounds. With this knowledge, the questionnaire had to be as clear as possible so that as many as possible would interpret the questions in the same way. The researchers of the survey were aware of the risks with different interpretations when reading the wording and analyzed the result according to the circumstances. The technology knowledge can vary a lot even between the digital natives. Some people are unable to use information technology and some people do not want to use it. This is called digital divide and is the name of the diversion that is built between the people who follow the technology trends and they who do not want to or can not. The diversion arises from different factors like developing and industrialized countries, socio-economic levels, Internet access, and divergences between people personal qualifications. In this study another aspect needed to be considered. The fact that digital natives are people born 1980-2000 is crucial to know about. This span in ages could affect the digital skills, access and expected result (Stieninger & Nedbal 2014). To minimize the risk of digital division the questionnaire were handed out to people who live in Gothenburg or Borås in Sweden. By doing this, the understanding of technology would be about the same for all participants since they been brought up under similar conditions when it comes to technology. The age difference and gender diversities will be taking into account and evaluated separately.
4. Empirical Findings

In this chapter, the researchers will present all the answers from the survey, which factors digital natives consider to be important for UX when using a MAR application and review the results from SPSS.

4.1 Questionnaire results

The study received a total of 155 responses from sharing the questionnaire via social media platforms and from handing them out at the University of Borås. All participants were between 18 and 38 years old. The 20-year span in the target groups’ age, were divided into five subgroups. The first group were 18 to 21 years old, the second group were 22 to 25 years old, the third group were 26 to 29 years old, the fourth group were 30 to 33 years old and the last group were 34 to 38 years old. To reach as many respondents as possible, the researchers distributed questionnaires on different social media platforms (Hoffman & Novak 2012), where respondents of different ages had the opportunity to participate online. Out of the 155 respondents, 9% were 18 to 21 years old, 42,6% were 22 to 25 years old, 29,7% were 26 to 29 years old, 8,4% were 30 to 33 years old, 10,3% were 34 to 38 years old.

In the survey, 61,9 % indicated that they were women and 38,1% that they were men, which means that more women than men participated in this study. The study will be discussed on the basis that there are two constructed genders since no significant number of participants was found in the study to who answered gender as other. Out of all 155 respondents who participated in the survey, 100% stated that they own a smartphone or a tablet. 60% of these participants responded that they knew about AR technology before they read the description about it in the beginning of the questionnaire. The rest of the respondents, 40% replied that they did not know about the AR technology and MAR applications before they read the text.

4.1.1 Perspicuity

By examining the factor perspicuity, researchers can find out how important it is for digital natives that a MAR application is easy to use and easy to understand (Laugwitz, Held & Schrepp 2008), the researchers want to measure how the degree of complexity affects UX when using MAR application and if it is important for the consumer that the application is clear.

The researchers’ first question was "How important is it that the MAR application is easy to use?"

Results:
1. 1 respondent, equal to 0,6%, did not think it was important.
2. 5 respondents, equal to 3,2%, thought it was less important.
3. 22 respondents, equal to 14,2%, thought it was just as important.
4. 55 respondents, equal to 35,5%, thought it was more important.
5. 72 respondents, equal to 46,5%, thought it was very important with an MAR application that is easy to use.
The researchers' other question was "How important is it that the MAR application is easy to understand?"

Results:
1. 1 respondent, equal to 0.6%, did not think it was important.
2. 5 respondents, equal to 3.2%, thought it was less important.
3. 11 respondents, equal to 7.1%, thought it was just as important.
4. 55 respondents, equal to 35.5%, thought it was more important.
5. 83 respondents, equal to 53.5%, thought it was important that a MAR application is easy to use.

4.1.2 Efficiency

This factor describes whether an MAR application is quick and functional to use. A structured and clear interface makes it easier for the user to orientate itself within a MAR application according to Albert (2013), who also said that an application is more efficient if it is quick for the user to perform tasks without any effort. By examining efficiency, the researchers want to find out if this topic is important for digital natives when using MAR applications today.
The researchers' first question was "How important is fast time response in a MAR application?"
Results:
1. 1 responder, equal to 0.6%, did not think it was important.
2. 1 responder, equal to 0.6%, thought it was less important.
3. 10 respondents, equal to 6.5%, thought it was just as important.
4. 52 respondents, equal to 33.5%, thought it was response is more important.
5. 91 respondents, equal to 58.7%, thought it was time response to an MAR application is very important.

Figure 3, Importance of fast time response.

The researchers' other question was "How important is it that the MAR application is functional to use?"
Results:
1. 0 respondents did not think it was important.
2. 4 respondents, equal to 2.6%, thought it was less important.
3. 12 respondents, equal to 7.7%, thought it was just as important.
4. 54 respondents, equal to 34.8%, thought it was more important.
5. 85 respondents, equal to 54.8%, responded that they thought functionality was very important in a MAR application.

Figure 4, Importance of functional use.
4.1.3 Dependability

Dependability stands for security and credibility and whether it is important to be able to rely on the developers behind MAR applications (Laugwitz, Held & Schrepp 2008). The researchers want to investigate whether these safety issues are important for digital natives.

The researchers' first question was "How important is it that the MAR application is developed by a reliable source?"

Results:
1. 3 respondents, equal to 1.9%, did not think it was important.
2. 15 respondents, equal to 9.7%, thought it was less important.
3. 34 respondents, equal to 21.9%, thought it was just as important.
4. 48 respondents, equal to 31%, thought it was more important.
5. 55 respondents, equal to 35.5%, thought it was very important that the MAR application is developed by a credible source.

The researchers' second question was "How important is it that the MAR application feels trustworthy and secure?"

Results:
1. 2 respondents, equal to 1.3%, did not think it was important.
2. 5 respondents, equal to 3.2%, thought it was less important.
3. 24 respondents, equal to 15.5%, thought it was just as important.
4. 43 respondents, equal to 27.7%, thought it was more important.
5. 81 respondents, equal to 52.3%, thought it was very important that the MAR application feels credible and safe.
4.1.4 Stimulation

The fourth factor describes how stimulation affects UX when using MAR applications. To investigate whether it is important for the respondents that the MAR application is stimulating when used.

The researchers' first question was "How important is it that the MAR application is interesting to use?"

Results:
1. 2 respondents, equal to 1.3%, did not think it was important.
2. 6 respondents, equal to 3.9%, thought it was less important.
3. 20 respondents, equal to 12.9%, thought it was just as important.
4. 53 respondents, equal to 34.2%, thought it was more important.
5. 74 respondents, equal to 47.7%, thought it was very important that an MAR application is interesting to use.

![Figure 7, Importance of interest.](image7.png)

The researchers' second question was "How important is it that the MAR application is fun to use?"

Results:
1. 1 respondent, equal to 0.6%, did not think it was important.
2. 5 respondents, equal to 3.2%, thought it was less important.
3. 18 respondents, equal to 11.6%, thought it was just as important.
4. 41 respondents, equal to 26.5%, thought it was more important.
5. 90 respondents, equal to 58.1%, thought it was very important that an MAR application is fun to use.

![Figure 8, Importance of fun.](image8.png)
4.1.5 Novelty

Fifth factor describes novelty and it stands for innovations and new creative functions in a MAR application according to Laugwitz, Held and Schrepp (2008). The researchers wanted to investigate this topic closer to see if that's true to digital natives.

The researchers' first question was "How important is it that the MAR application has a creative interface?"

Results:
1. 4 respondents, equal to 2.6%, did not think it was important.
2. 7 respondents, equal to 4.5%, thought it was less important.
3. 35 respondents, equal to 22.6%, thought it was just as important.
4. 56 respondents, equal to 36.1%, thought it was more important.
5. 53 respondents, equal to 34.2%, thought it was very important that an MAR application has a creative interface.

The researchers' second question was "How important is it that the MAR application has creative features?"

Results:
1. 1 respondent, equal to 0.6%, did not think it was important.
2. 3 respondents, equal to 1.9%, thought it was less important.
3. 20 respondents, equal to 12.9%, thought it was just as important.
4. 73 respondents, equal to 47.1%, thought it was more important.
5. 58 respondents, equal to 37.4%, thought it was very important with creative features.
4.1.6 Two important factors and the Respondents’ Own Comment

After the respondents answered all questions about the five different factors; perspicuity, efficiency, dependability, stimulation and novelty, they had to select two of the factors that they though were the most important when using MAR applications, this was done in order for the researchers to get a clear overview of what the participants thought.

The results that the researchers obtained for the most important factors for UX when using an MAR application, where one is the most important factor and five is the least important:

1. Perspicuity, 75 respondents, 48,4%
2. Novelty, 69 respondents, 44,5%
3. Efficiency, 68 respondents, 43,9%
4. Stimulation, 50 respondents, 32,3%
5. Dependability, 48 respondents, 31%

Figure 11. A scale where the most important factors are ranked.

On the last question in the survey, the respondents could fill in their own comment, regarding what they thought were important for a good MAR application.

The results were as follows:
• Easily accessible.
• No purchases inside the app.
• Functional safety.
• No bugs.
• Usability and realism.
• Fast response time, no delay.
• Easy to use - release new features.
• Professionally executed.
• Security and reliability.
• The technology should be compliant - not hassle.
• The app developers should releases new features often.
• Available in English version/text.
• The app should facilitate for the user.
• Innovative functions and arousing interest are important in competition - not decisive otherwise.
• The AR technology must have an important function.
• Updated range - Functions do not get old.
• Clean - organized application.
• Security & data protection - reliable encryption to protect identity, personal data and spatial data.
• Colorful, reality-based and interesting.
• Simple and fast.
• Precision - ex. IKEA place application.

4.2 Division between genders

Out of 155 persons who participated in the survey, 96 were female and 59 male. Since the survey was shared on social media platforms, no control of equal participants of women and men could be done. The five categories of UX each contained of two questions, like mentioned in section 3.4, from where the mean value was extracted. The mean was found after all participants were divided into two groups, men and women.

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
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<td>How important is it that the AR application is easy to use?</td>
<td>Women</td>
<td>96</td>
<td>4.24</td>
<td>.805</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.24</td>
<td>.953</td>
<td>.124</td>
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<tr>
<td>How important is it that the AR application is easy to understand?</td>
<td>Women</td>
<td>96</td>
<td>4.45</td>
<td>.724</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.27</td>
<td>.925</td>
<td>.120</td>
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<tr>
<td>How important is fast time response in an AR application?</td>
<td>Women</td>
<td>96</td>
<td>4.45</td>
<td>.709</td>
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<tr>
<td>Men</td>
<td>59</td>
<td>4.54</td>
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<td>.091</td>
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<tr>
<td>How important is it that the AR application is functional to use?</td>
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<td>4.41</td>
<td>.762</td>
</tr>
<tr>
<td>Men</td>
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<td>4.42</td>
<td>.724</td>
<td>.094</td>
</tr>
<tr>
<td>How important is it that the AR application is developed by a reliable source?</td>
<td>Women</td>
<td>96</td>
<td>3.94</td>
<td>1.064</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>3.78</td>
<td>1.052</td>
<td>.137</td>
</tr>
<tr>
<td>How important is it that the AR application feels trustworthy and secure?</td>
<td>Women</td>
<td>96</td>
<td>4.39</td>
<td>.851</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.05</td>
<td>1.007</td>
<td>.131</td>
</tr>
<tr>
<td>How important is it that the AR application is interesting to use?</td>
<td>Women</td>
<td>96</td>
<td>4.20</td>
<td>.841</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.26</td>
<td>1.027</td>
<td>.134</td>
</tr>
<tr>
<td>How important is it that the AR application is fun to use?</td>
<td>Women</td>
<td>96</td>
<td>4.51</td>
<td>.696</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.14</td>
<td>1.056</td>
<td>.138</td>
</tr>
<tr>
<td>How important is it that the AR application has a creative interface?</td>
<td>Women</td>
<td>96</td>
<td>4.10</td>
<td>.912</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>3.68</td>
<td>1.058</td>
<td>.138</td>
</tr>
<tr>
<td>How important is it that the AR application has creative features?</td>
<td>Women</td>
<td>96</td>
<td>4.28</td>
<td>.764</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>4.02</td>
<td>.777</td>
<td>.101</td>
</tr>
</tbody>
</table>

Table 1. Group statistics between gender.
Perspicuity: When it comes to how important an easy usage and understanding is, while using MAR applications, the participants answered similar. The answers showed a high affection towards easy using and easy understanding. Same mean could be seen between men and female when only looking at the importance of easy to use. There was a small difference when looking at the importance of easy to understand. The stimuli every user is affected by when using applications needs to be easy to use and understandable according to the research survey outcome.

Efficiency: The efficiency questions answered by the participants concerned both elapsed time and functionality. Men considered a fast response time to be slightly more important than woman but the differences were insufficient. Same analys could be made from functionality. Same for both genders are that consumed time and functionality score high numbers, which means that many people find these topics important.

Dependability: The researchers had a hypothesis about people finding security as a highly important factor to consider when using new applications. The answers showed high importance but they differed some between the genders. Men tended to trust in unreliable sources more than women and they also thought less about security while using it.

Stimulation: When looking the answers for how important an interesting usage and fun usage of the application, it showed that women found this more important than men to have a fun application, while men found an interesting application more important.

Novelty: Digital natives always want to have new impressions. Creative interfaces are becoming more important than ever and clever solutions are what this generation wants. Interesting was that women found creative solutions and interfaces to be more important than men.

To summarize the results from the gender division, this study showed several significant factors. The first one is the second question about trustworthiness in the dependability factor showed significant under 0.05. This group differed in significant compared to the other question in the same group. Same pattern could be seen for the second question, about fun applications in the stimulation factor. The last factor novelty, showed significant under 0.05 in both of the questions.
4.3 Division between age

There is a quite large age range of digital natives that extend between 18-38 years old. Education, knowledge and life experiences can differ greatly between these persons, which can affect the perception of UX in an application. Therefore the researchers divided the results of the survey into age groups. Digital natives in the age between 18-25 were divided in one group and 26-28 years old in another. There were 79 participants in the age between 18-25 and 77 participants between 26-38, the results is presented in the table below.

Table 2, T-test for gender.

<table>
<thead>
<tr>
<th>How important is it</th>
<th>Equal variances assumed</th>
<th>Equal variances not assumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>the AR application is easy to use?</td>
<td>.987</td>
<td>.988</td>
</tr>
<tr>
<td>the AR application is easy to understand?</td>
<td>.187</td>
<td>.214</td>
</tr>
<tr>
<td>the AR application is functional to use?</td>
<td>.888</td>
<td>.886</td>
</tr>
<tr>
<td>the AR application is developed by a reliable source?</td>
<td>.369</td>
<td>.368</td>
</tr>
<tr>
<td>the AR application feels trustworthy and secure?</td>
<td>.028</td>
<td>.036</td>
</tr>
<tr>
<td>the AR application is interesting to use?</td>
<td>.711</td>
<td>.724</td>
</tr>
<tr>
<td>the AR application is fun to use?</td>
<td>.009</td>
<td>.018</td>
</tr>
<tr>
<td>the AR application has a creative interface?</td>
<td>.009</td>
<td>.012</td>
</tr>
<tr>
<td>the AR application has creative features?</td>
<td>.039</td>
<td>.041</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>.002</td>
<td>.143</td>
<td>-2.80</td>
</tr>
<tr>
<td>.177</td>
<td>.133</td>
<td>-0.087</td>
</tr>
<tr>
<td>.177</td>
<td>.141</td>
<td>-1.04</td>
</tr>
<tr>
<td>-.094</td>
<td>.117</td>
<td>-.325</td>
</tr>
<tr>
<td>-.007</td>
<td>.124</td>
<td>-.262</td>
</tr>
<tr>
<td>.158</td>
<td>.175</td>
<td>-.188</td>
</tr>
<tr>
<td>.335</td>
<td>.151</td>
<td>.036</td>
</tr>
<tr>
<td>.335</td>
<td>.157</td>
<td>.023</td>
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<tr>
<td>-.056</td>
<td>.152</td>
<td>-.356</td>
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<td>-.056</td>
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<td>-.371</td>
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<td>.375</td>
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<td>.097</td>
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<td>.375</td>
<td>.155</td>
<td>.067</td>
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<td>.426</td>
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<td>.109</td>
</tr>
<tr>
<td>.426</td>
<td>.166</td>
<td>.097</td>
</tr>
<tr>
<td>.264</td>
<td>.127</td>
<td>.013</td>
</tr>
<tr>
<td>.264</td>
<td>.128</td>
<td>.012</td>
</tr>
</tbody>
</table>
Table 3, Group statistics between age.

Perspicuity: The participants answers were similar in this case. The both groups basically had the same mean on importance of easy to use, there was a small difference in the question about understanding an application where the older participants thought this was less important than the younger.

Efficiency: Fast time response in an application was slightly more important for the older group than the younger. Regarding functionality the two groups have equal answers.

Dependability: In this subject, the two groups differ more from each other. The older participant attaches more importance to the application coming from a reliable source. There was also a clear difference in the importance of the application feeling trustworthy and secure. This factor was more important to the participants between 26-38 in comparison to the younger target group.

Stimulation: The mean value of the questions that measures if it is important that a MAR application is interesting to use was the same. The two groups answers led to the same result. In the second question the participants answered if it was important that an MAR application
was fun to use and here it was a difference. The younger group thought this factor was more important than the older group.

Novelty: Creativity is important to the digital natives and from the results in the table the older group thinks that a creative interface was more important while the younger group thought it was more important with creative features in an MAR application.

Analyzing the results from the T-test further in the table below the researchers searches for a variable that stands out as a significant factor. Unlike the division in gender the results in the table for division in age gave no significant factor under <0.05.

Table 4, T-test for age.
5. Discussion

Based on the empirical findings, the important factors in this chapter are identified and analyzed. Needs for a successful MAR application, differences in gender roles and age among the respondents are discussed.

Throughout the study the focus was on finding the answer to which factors of UX in MAR applications are most important according to the digital natives. The choice of focusing on digital natives was because of their early adoption to mobile products and to new technology (Prensky 2001). They are also more open to technologies they do not know all too well. Since they have higher demands on technology, the researchers felt like they were the right group to focus on. This was just supported by the fact that research in this area was lacking (Kilian, Hennigs & Langner 2012).

5.1 Important factors

Using a 1-5 scale (not important-very important) the researchers first believed that there could be a risk that the respondents would only answer 5 as in "very important" on every question regarding UX in MAR application. The answers ended up different on the various questions, which refuted the researchers concern. The results could be of great importance for application developers, companies and different stakeholders of MAR applications.

The most important factors according to the digital natives that took part in the survey were perspicuity and after that novelty close followed by efficiency.

Companies or other stakeholders without knowledge of the importance of perspicuity can risk neglecting this factor when developing MAR applications. Since digital natives have a high knowledge about innovative technology, the stakeholders might think they want an advance interface but in fact, previous studies and this research as well concluded perspicuity to be more important (Kilian, Hennigs & Langner 2012). According to the results, the most successful MAR application is easy to use and easy to understand. The researchers believe this is an obvious factor to consider and important to apply, but also easy to underestimate.

Novelty, which became the second most important factor, had most people answer 4 on the 1-5 scale. The researchers interpret these results as very important for a MAR application to be successful but not entirely decisive. Nevertheless, the researchers consider that all stakeholders should take this data into account in order to succeed as the results of the study pointed out that a MAR application should have creative features and a creative interface to be successful among digital natives. Unexpected positive experiences are of special importance as well since the users then tend to use the application more (Kim 2015).

Efficiency were elected as the third most important factor by the respondents, showing that time response and functionality are very important to keep in mind when developing MAR applications for digital natives. More than half of the respondents answered 5 as in very important, which also confirms previous studies that digital natives want the technology to respond quickly. Mostly because they have less patience and are more discerning than previous generations (Prensky 2001). The respondents also answered that functionality were very important. Guidelines could be prosperous to use when releasing a new MAR
application that is perceived as fast, well made and keeps a high quality. Since a slow application is a poorly developed application and will not succeed among this discerning generation (Prensky 2001).

Digital natives believed that an application should be fun and interesting to use, as almost more than half of the respondents answered 5 as in very important. But when the respondents had to pick out the two most important factors, stimulation ended up almost at the bottom of the list. The researchers believe that this is important data to anyone who may think that just a fun application are needed in order to succeed. This could end up in too much time being spent developing applications that will stimulate the user and leave the rest to chance. If all factors are not considered it can lead to the application not becoming successful.

Respondents chose dependability as the least important factor. This strengthens previous research that says the generation of digital natives is aware of risks but does not care about online security. They provide sensitive data about themselves without considering consequences (Palfrey & Gasser 2008). Digital natives rely on the companies behind the application without checking them before starting to use their products (Brombacher 2007). The researchers interpret this generation as very naïve when it comes to security issues and online privacy. This generation lacks expertise in risks and threats, as they apparently do not seem to care. This data can be of good use to application developers that do not have a strong and well-known brand but want to start up a new MAR application for digital natives. The generation is eager to try new innovative applications and do not care if the developer is credible and well known since before.

The researchers added one open-end question in the end of the questionnaire to give the participants in the study the option to respond with their own comments on UX in MAR applications. 21 extra comments were submitted from 155 participants. Since it was an option to answer the question or not, the researchers knew that not everyone would answer. Some of the answers could be associated to the five factors like the comment; security and reliability, which could be correlated to the reliability factor. Two comments stood out from the rest that did not really fit in the chosen theoretical framework for this study; Update range- functions that do not get old and Reality based applications. Continuous updates from the developers are important so that the application can keep its interest from the users. The willingness that the application should be reality-based strengthens the researchers argument about the importance of vividness in section 1.3.

All of the answers could be of good use in future studies since it can help researchers to write clearer questions. The answers that were already about given factors could be an indication that the participants did not understand the question in the researchers desired way. It can also help future research in writing questions about other factors since the result gave an indication what other factors outside of the theoretical framework were important to the users of MAR applications. According to the researchers the information collected from the open-end question is providing vital information and more specific information for stakeholders.

5.2 Divisions in Gender and Age

Both females and males found all five factors important and valued them high on the 1-5 scale. This also supports the fact that Wang, Myers and Sundarm (2013) stated about gender division for digital natives are neutralized and that both female and male adopt to new technologies faster and with more enthusiasm. Another study showed other results, which
were that men are more technologically motivated and they are more involved in new developments than women. According to Volman et al. (2005) women do not use new technology as much as men do, while Wang, Myers and Sundarm (2013) believe that this is not true among digital natives, because both women and men use the technology just as much these days. This study shows partly this result, but also counteracted it since the male answers did not always show a higher result than female, which could be an indication of a higher affection and motivation toward AR technology and products. After analyzing the result of the questions answered by a scale, the researchers found that women want more fun applications. The result also showed that women want to have more creative solutions and the researchers see a resemblance in these two areas. Previous studies show that females have a more negative approach to using computer and the Internet and they also show more anxiety signs when using computers (Broos 2005). As the study did have more female participants than men, this could show a higher engagement among women and the opposite of a negative approach towards technology. For future research, development and in the end marketing this could be of good use if the solution is to be focused on a specific gender category. Another thing that the researchers found as something to discuss was the fact that both groups answered the lowest in the dependability factor, which were about security. This was especially for the question about reliable sources. According to the researchers this could be devastating and they see a huge problem in people not realizing the problem that occur when miscellaneous applications look like trustworthy ones and people trust in them (Molnar 2014).

Prensky (2001) explained in his article that the fast moving technology was changing the way student’s process information. This creates conflicts between the digital natives and the digital immigrants at work, in school and even at home between children and their parents. Children who are raised in the digital area also requires a media-rich learning in school and at work with a supervisor that speaks the same digital language and not a digital immigrant instructor that speaks an outdated language. Growing up with technology gives these children a lack of patients. They expect a faultless flow in activities and daily operations, as well as fast time response in applications and other digital tools. Prensky did not define the digital natives to a specific age in his article in 2001, but later on, the generation was set to children born after 1980 since computer bulletin boards were already in use at the time (Kilian, Hennigs & Langner 2012). The researchers divided the participants into two groups before doing a T-test. Fast time response was slightly more important for the older group than the younger. Compared to previous research, this result contradicts previous hypotheses. Although, the researchers did not want to take for granted that it could be the number of participants who mislead the result. As young and old people differ in their sources of information and their ability to learn, it affects the information processing. This could lead to relevant marketing differences between the young and the old people as well. Previous research states that it is important to focus on the effect of different market strategies depending on whether it is aimed at a younger target group or an older one (Philips & Sternthal 1997). The researchers of this study therefore wanted to investigate if there were any differences in perceptions about UX in MAR applications in ages within the digital natives. Perspicuity was more important to the younger crowd of digital natives since their answers showed a result telling how it was more important for them that applications was easy to understand. This go hand in hand with the previous research saying that digital natives have no patience (Prensky 2001). The researchers conclusion of this connection is that the younger digital native have less patience and therefore do not want to waste time learning how an application works.
The T-test showed if there were any significant differences between the compared means. The column “Sig. (2-tailed)” described in the column if the mean value were significant. If the value is below <0.05, the difference is significant with 95 percent security. That is, the difference found in the random selection survey can be found with 95% security also in the larger population (Startstedt & Mooi 2014). Overall there were not any significant differences among ages within the digital natives. Although, the researchers had some deviations within the gender division where the significance level was lower than <0.05. Dependability and stimulation were the first factors to show a significant result. In both of the factors it were the second question that had a value less than 0.05. The questions were regarding is trustworthiness and if it was important for an application to be fun. One factor showed significant values in both questions were novelty. This means that the researchers can trust that these results reflect the larger population with 95% security. Both men and women showed significant in the same factors after evaluation.

Previous research takes up possibilities with technology that are not yet widely spread. AR can help in many ways like in giving instruction. The one who is being given the instruction can take in more if the person gets the information both visually and orally. Since the human access a majority of the information via vision, AR is a useful tool (Porter & Heppelmann 2017). AR could impact the UX according to Poushne & Vasquez-Parraga (2016), which was proven in this study by asking the participants UX questions. The questions did not ask about the comparison to other applications neither was the study based on that, which means that no measures of what is more important compare to other technologies was made. The result then shows what the participants find important in this study but will not reflect what is not mentioned in this study. This could mean that other factors could be more important to digital natives and also it does not show if the participants even supports MAR applications. If the researchers would to add all possible factors to this study or let everyone make up by themselves what is most important it would result in many different answers and no clear picture could probably be given.

The research had respondents within each age group but the age groups 22 to 25 years old and 26 to 29 years were over-represented. The reason why these age groups are overrepresented in the survey, believed to be because of these age groups overrepresentation among students at the University of Borås where students participated in the survey offline. The researchers are aware that this can affect the result for older and younger target groups who are underrepresented in the study. Another factor to take into account is that the researchers are in these age groups as well and will most likely reach out to more people in the same age.
6. Conclusion & reflection

This chapter describes the conclusion of the study based on the empirical findings and discussion chapter, the researchers will answer their research question, evaluate their method, describe what the study will contribute with to the field of informatics and suggest future research in the area.

6.1 Conclusion

The purpose of this study was to provide knowledge about MAR applications in relation to UX according to digital natives. Previous research stressed that information about these fields in combination is weak, while the technology is still constantly growing (Irshad & Rambli 2015; Kilian, Hennigs & Langner 2012). Answering the research question will fulfill the purpose of the research.

What are the most important factors of user experience in mobile augmented reality applications according to the digital natives?

The result from the conducted study showed that Perspicuity, Novelty and Efficiency were, in this order, the factors that the digital natives thought was the most important. Digital natives in particular want the MAR application to be easy to learn and easy to understand. It should consist of a creative interface with creative features inside and also respond well with fast time response. The structure in the MAR application should be constructed in a way that makes it organized and functional to move around in.

The factors mentioned above can affect which of the features to prioritize when developing a MAR application in the future. These have to be taken into account if the enterprises behind the application are targeting the generation of digital natives. Evaluate what the expected application needs to succeed and then weight these against what the target group think is most important features to include. These choices can have a decisive impact on whether the MAR application will succeed in the market.

6.1.1 Further reflections

Based on the analysis and discussion in this thesis, the most important factors of UX in MAR applications have been identified and new knowledge has been developed. It was concluded that perspicuity, novelty and efficiency were the most important factors. Followed by stimulation and dependability in the order presented below;

1. Perspicuity
2. Novelty
3. Efficiency
4. Stimulation
5. Dependability

Compared to all the above mentioned features the one with the lowest median value is dependability. This states that the digital natives do not think that security in MAR applications is particularly important as to other features, nor that it comes from a reliable
source. Several external factors outside of the predetermined theoretical framework was collected and analyzed but only two was identified as new contribution to the field. Maintenance of the application with continuous updates, and for a MAR application to be successful it needs to be reality-based in line with previous research that stresses the importance of vividness. The other collected external factors were associated with already predetermined factors and did not bring anything new to the study.

In the division between the younger group of digital natives and the older group, it was identified that fast time response was slightly more important for the older group. Men and women had overall the same perceptions regarding the five factors. One thing that stood out were that women wanted more fun and creative applications. In the end the study showed significant factors in the gender division, these reflect the larger population with 95% certainty;

- Dependability - trustworthiness and security
- Stimulation - fun and interesting
- Novelty - creative interfaces and features

6.2 Evaluation of method

For this study the researchers conducted a quantitative method with an inductive approach. This method was chosen in order to reach as many participants as possible of the target group, the digital natives.

Alternatively the researchers could have conducted in-depth interviews with a few participants, which would allow a deeper analysis within the subject. However, only having a few participants in the survey could harm the overall perspective of the digital natives and thereby prevent the researchers to obtain a real picture of the target groups attitudes regarding UX in MAR applications. The researchers also had an idea of performing a case study in combination with the questionnaire where the participants could test the interface of a predetermined MAR application and then fill out a questionnaire. This combination would be performed to avoid confusion in the survey due to the participants not previously using an MAR application. The participant’s perception of AR and MAR application may not be good enough to give a real picture. But with a given explanation about AR the researchers came to the conclusion that the chosen method would be the best suited for this project measures.

An internal pilot survey was conducted. Internal means that the respondents in the pilot study will also be the first participants in the main survey (Sincero 2012). Conducting a pilot study resulted in improvements of the survey. Some questions were asked in a way that made the participants understand the question in a different way than it was anticipated. This gave the researchers a possibility to review these answers directly in the main survey to see if the amendments of the questions gave new results or if more changes needed to be done. The pilot study led to a reviewed and improved survey that was later shared on social media platforms and as a physical survey to students at University of Borås.
6.3 Contribution to the area of informatics

Informatics is an area of science within information technology. It explains how the technique is shaped and used. New areas of research within this field involve mobile systems and different ways of communication. Informatics emphasizes the importance of understanding social contexts where IT is being used and how they can be converted into practical tools (Nationalencyklopedin n.d.). This study was conducted in order to develop knowledge about important UX factors which will bring the field closer to understanding how digital natives interact with MAR applications. Based on the theoretical framework, perspicuity, novelty and efficiency were stated to be the most important factors according to the digital natives. This information was not known before within the field.

The study both confirmed and contradicted previous research by establishing new knowledge about the area. AR technologies and MAR applications is constantly in a developing phase and with this comes changes in both perceptions and technology. Therefore, a recommendation is further research in the area to strengthen the conclusions. Another contribution to the field is the awareness and knowledge to new and unknowing users of MAR applications. The researchers believe this to be crucial in the future of AR, that people learn more about the technology.

6.4 Future research

The researchers see development potential in different areas within the field. Research on AR and MAR applications can never be completed, as technology always changes (Cascio & Montealegre 2013). That is also why there is always something new to discover. The survey could contain of even more and different questions that would give a more extensive knowledge about what AR and MAR users value. Different factors than the ones that are already examined could be used to measure other factors level of importance. More factors could possibly broaden the field of knowledge on UX in MAR applications. This study was based on UX in general but more specific UX areas could be examined as well. Sound is one thing that could be considered as an important area, which might not be the first area to think of. The researchers automatically focused on the visual aspects in MAR applications since the technique is about projecting digital images on the reality. Questions about what the users dislike with AR is not included in the study. A study on the negative sides of AR would strengthen the field further. AR could also be compared to other mobile application technologies to extend the research field.

The researchers also suggest to further spread the knowledge about AR and to encourage the industry to develop more solutions and applications. The applications on the market get big medial attention and people within the industry believe in the future of AR (Stjernstedt 2019).
7. References


Chordas, L. (2013). Spreading the word. *Best’s review.*, 5, pp. 30-32. ISSN:15275914


Appendix

Questionnaire

User Experience in Augmented Reality:
Augmented reality (AR) is a technology that combines the real world with digital images. 3D images are projected in real size on what we see, through the mobile camera. For example, it is used in the Pokémon Go mobile game when players can see Pokémon on the street. Another example is Snapchat photo filter. Applications like these are called mobile augmented reality (MAR) applications. This survey is directed to the generation known as "digital natives" (people born 1980-2000). The study is about identifying which factors regarding the user experience that these people think are important for MAR applications.

You as a participant will be anonymous and the result will be presented to the University of Borås for a Bachelor of Science in Informatics.

General Information
1. How old are you?
2. Gender?
3. Do you own a smartphone or a tablet?

Knowledge and Experience
4. Did you know about MAR before reading the text above?
5. Have you ever used an MAR application before?

Perspicuity
6. How important is it that the MAR application is easy to use?
7. How important is it that the MAR application is easy to understand?

Efficiency
8. How important is fast time response in a MAR application?
9. How important is it that the MAR application is functional to use?

Dependability
10. How important is it that the MAR application is developed by a reliable source?
11. How important is it that the MAR application feels trustworthy and secure?

Stimulating
12. How important is it that the MAR application is interesting to use?
13. How important is it that the MAR application is fun to use?

Novelty
14. How important is it that the MAR application has a creative interface?
15. How important is it that the MAR application has creative features?

Other Questions
16. Cross in the 2 most important factors that you value in a MAR application: Perspicuity Efficiency Dependability Stimulating Novelty
17. Is there any other user experience related factors (besides from those mentioned above) that you think is important on a MAR application?
University of Borås is a modern university in the city center. We give education programs and courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

At the Department of Information Technology, we have focused on the students' future needs. Therefore, we have created programs in which employability is a key word. Subject integration, wholeness and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses and programs with a major in informatics are centered around basic concepts as system development and business development. In our wide range of specializations there is everything from programming advanced systems, analyze the needs and requirements of businesses, to conduct integrated IT and business development, with the common purpose of promoting good use of IT in enterprises and organizations.

The department is carrying out IT-related research within the university’s research area called Business and IT. In terms of field, the research activities are mainly within computer and systems science. Particular areas of focus are data science and information systems science. Both scientifically and professionally-oriented research are performed, which among other things is manifested through that research is often conducted based on domain specific needs of business and government organizations at local, national and international arena. The professionally-oriented research is also often manifested through our participation in the Swedish Institute for Innovative Retailing (SIIR), which is a research center at the University with the aim of contributing to commerce and society with the development of innovative and sustainable trade.